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KARAFUTO MASU CHIGYO NO KOKAIKI NI TSUITE (A NOTE ON THE SEAWARD MIGRATION OF PINK SALMON FRY) p. 1

Tetsu KOBAYASHI

Hokkaido Sake · Masu Fukajo Kenkyu Gyoseki (Scientific Report of Hokkaido Salmon Hatchery), 22, 1968, pp. 1-5.

I Introduction

It is known that pink salmon fry hatched artificially start their seaward migration very quickly when they are released and their activity is quite different from that of salmon fry. However, there has been hardly any chance of investigating pink salmon fry hatched naturally. There is only information about the seaward migration of pink salmon fry obtained when this author conducted an ecological investigation of salmon fry in the Nishibetsu River (Kobayashi and Harada, 1966). According to this, it is known that the period of seaward migration of pink salmon fry hatched from natural spawn is from the middle of April to the beginning of May and that the most active migration occurs from the end of April to the beginning of May. The spawning of pink salmon occurs one or two months earlier than that of salmon. In spite of the earlier spawning, the period of seaward migration

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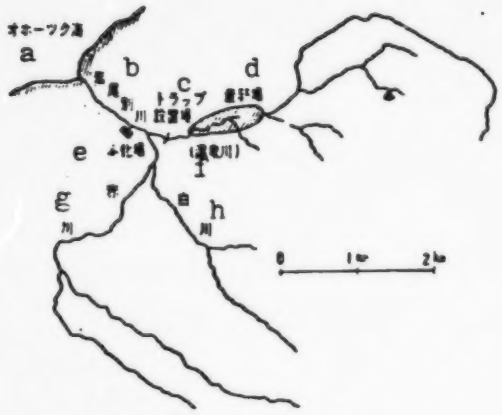
of fry is from April to June which is same as that of salmon. This suggests that there is a strong seasonal relationship between the preservation of the species and favourable biological production.

In order to obtain basic data for the reproduction of pink salmon, 50 mature females and 50 males were released in the upper stream (the Onsen River) of the Iwaobetsu River in October 1965. The spawning mechanism (Kobayashi, 1967) and the development of fry from the spawning ground were observed. Here the author would like to report the results of the observations and to present them as basic data for the recovery of pink salmon resources.

I would like to thank Mr. Kenji KAWAGUCHI, Head of the Iwaobetsu Project, Hokkaido Salmon Hatchery and the members of Kitami Branch for their assistance in producing this report.

II Method

50 matured females and 50 males were released on October 8, 1965 in the upper stream of the Iwaobetsu River (the area about 1-2 km from the junction with the Onsen River) and were let to spawn naturally. The spawning occurred during the period of the 9th to the 10th of October. The spawning area was kept completely natural. The ivestigation of fry was commenced on April 1. The investigation was conducted day and night through hourly observation by setting up a trap for fry investigation (Kobayashi, 1964) about 500 m downstream from the spawning area. The Iwaobetsu River and



第1図 岩尾別川並調査定点

Fig. 1 The Iwaobetsu River and the point of investigation

a. the Sea of Okhotsk, b. the Iwaobetsu River, c. Location of trap, d. Spawning ground, e. Hatchery, f. the Onsen River, g. the Aka River, h. the Shiro River

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the point of observation are shown in Fig. 1.

The analysis of food habit was conducted as the analysis of feed in the stomach and its wet weight was measured. The contents were weighed and classified.

III Outline of the Iwaobetsu River

The Iwaobetsu River is located near the tip of the Shiretoko Peninsula. The source of the river is at the side of the Mount Rausu. Two tributaries, the Shiro River and the Aka River join at the point 1.2-1.6 km from the mouth of the Iwaobetsu River which flows into the Sea of Okhotsk (cf. Fig. 1).

The basin area is 55.09 km^2 and most of the area is occupied by virgin forest. Settlers were made to immigrate to this

region after the war, however, it is uninhabited at present. This river is one of the few virgin rivers in Hokkaido. The drift is about 7 km and geographically it is a very swift stream. As a result, the fluctuation of the quantity of water is great due to snowfall and rainfall. It is especially great in the Onsen River (the main stream) which has a cleared plateau upstream.

From old times, the Iwaobetsu River has been known as a salmon river where many pink salmon and cherry salmon go upstream; pink salmon mainly in the Onsen River (the main stream) and cherry salmon in the Shiro River, the main stream. The Iwaobetsu Hatchery is located 300 m downstream from the junction (about 1,200 m from the mouth of the river). It releases mainly pink salmon followed by cherry salmon and only a few salmon.

Spring water (pH 4.5-5.0) containing a large amount of sulfate permeates in several places on the left bank. Therefore the pH of water in the downstream of the Iwaobetsu River is weak acid of about pH 6.5. Especially the tributary, the Aka River, has a low water content but pH is 4.8-5.0 and no fish live in it. On the other hand, water in the Onsen River (the main stream) and the Shiro River shows weak alkali of pH 7.3-7.5. There is a hot spring in the upper stream of the main stream.

An analysis of water from the Onsen River in which pink salmon were spawned naturally is given in Table 1.

Table 1 Property of water in the Onsen River

第1表 温泉川の水質

a 年 月	pH	C.O.D ppm	CL ppm	SO_3 ppm	CaO ppm	SiO_2 ppm	b 硬 度
1951, 8	7.5	0.52	42.00	47.04	32.06	7.6	4.25
1966, 10	7.3	0.96	34.59	-	-	-	-

a. Year, month, b. Hardness

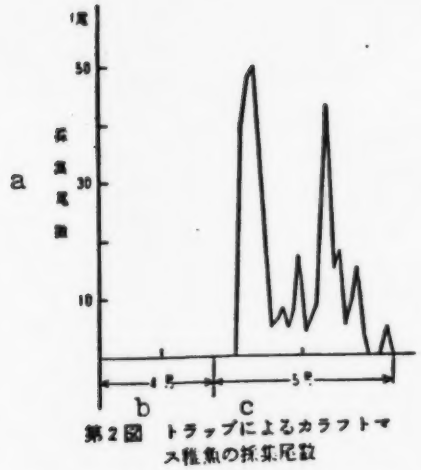
IV Seaward migration of fry

1) Seaward migration of natural fry

The seaward migration of fry spawned naturally in the area about 2-3 km from the mouth of the river on October 8 is given in Fig. 2.

As is shown in the figure, one fry appeared for the first time in the trap set for the investigation on April 21. There were no appearances for a while. Then from May 5, the seaward migration commenced in mass and ended on May 30. The seaward migration of fry occurred more often at night than in the evening (between 17.00 and 22.00).

The number of natural spawn of pink salmon was thought to be limited to those of the 50 pairs released. This is because the upstream movement was prevented almost completely by a blockage set at the mouth of the river. However, a part of it was broken due to the rise of the river water 2 weeks before the experiment. 2 males were confirmed to be present in the whole area of the Onsen River. They were thought to have escaped and swam upstream at that time. However, any female parent or a formation of spawning bed was not confirmed.



第2図 トラップによるカラフトマス稚魚の採集尾数

Fig. 2 Number of pink salmon fry collected by the trap

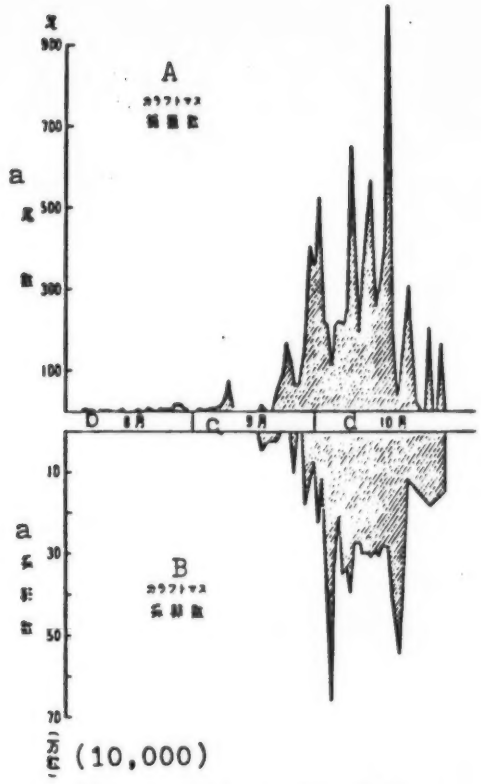
a. Number collected, b. April, c. May

There were no escapes nor upstream movement thereafter.

Therefore it is considered that the object of this experiment was the fry spawned from the experimental parent fish released in the Onsen River on October 8. From the night of May 7 when the seaward migration of fry in mass commenced, rain fell and the river water rose so much that the river bed of the spawning area changed. This rise occurred at the time when the fry were emerging from the gravel. Therefore it was assumed that the seaward migration of fry in mass occurred at the same time.

When the river water rose, a calculation of the fry in the trap was not conducted. As a result, the number of fry spawned and the effect of natural spawning were not grasped

p. 3



第3図 カラフトマス捕獲数，採卵数

Fig. 3 Number of catch of pink salmon and of collected eggs

A. Number of catch of pink salmon: a. Number, b. August, c. September, d. October
B. Number of eggs collected from pink salmon: a. Number of collected eggs (10,000)

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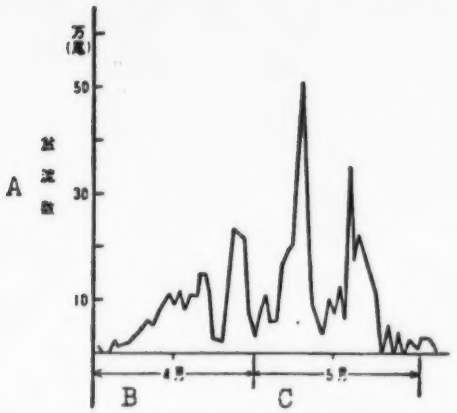
sufficiently.

However, from the condition of the fry remained after the rise, in the case of natural spawning, it is possible that not so many fry were washed away with the rise as was generally thought.



第4図 人工孵化稚魚の放流数

Fig. 4 Number of release of artificially hatched fry

A. Number of release (10,000), B. April, C. May

② Catch, collection of eggs and release of parent fish for artificial hatching

The catch of parent fish and the collection of eggs are shown in Fig. 3. As is shown in Fig. 3, the upstream movement was highest during the period of early to middle of October. The collection of eggs was also highest in the period of early to middle of October and the same as that for a group of naturally spawned.

The group of fry hatched from the collected eggs were released after the absorption of the umbilical sac in regular succession from the hatchery located 500 m downstream from the trap observation point. The release condition is given in Fig. 4.

For the release, peaks occurred in the middle of

Table 2 Body length and weight of fry

第2表 稚魚の体長，体重

A 月 日	B 体長 (mm) 範 a 囲	平 b 均	C 体重 (g) 範 a 囲	平 b 均
5.5 ～ 5.10	30 ～ 40	34.71	0.17 ～ 0.33	0.24
5.11 ～ 5.20	30 ～ 38	35.19	0.16 ～ 0.28	0.21
5.21 ～ 5.31	30 ～ 40	34.89	0.16 ～ 0.28	0.21
a 5.12(人工孵化稚魚)	28 ～ 38	34.70	0.19 ～ 0.30	0.26

A. Month, date: a. (Artificially hatched fry), B. Body length: a. Range, b. Mean, C. Body weight: a. Range, b. Mean

April, early May and from the middle of May to the end of May respectively. The total number of release was about 4,800,000.

Water used for hatching in the Iwaobetsu Hatchery is conducted from the Onsen River (the main stream) and the water temperature in the spawning period is about 13°C. However, the water temperature varies greatly. It goes down to 0°C in the depth of winter and it goes up again to 2°C-9°C from April to May in the release period.

V Growth and feeding condition of fry p. 4

Growth: Mean body length and weight of fry collected from the trap are given in Table 2. The fork length was used for the body length.

As given in the table, the growth of fry in the period of 10 days is 30-40 mm for the body length (fork length), an average of 34.7-35.2 mm, 0.16-0.33 g for the body weight, an average of 0.21-0.26 g. No seasonal growth and change are found. On the other hand, the artificially hatched fry

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Table 3 Feeding condition

第3表 摂 餌 状 態 (*＋胃袋1/3以下充満)

A 月 日	B 標本数	C 摂餌個体数*				
		a 無し (%)	b 有 (%)			C 平均重量 (mg)
			−	＋＋	＋＋＋	
4.21 ～ 5.10	141	126 (89.4)	15(10.6)	—	—	0.99
5.11 ～ 5.20	105	91 (86.7)	14(13.3)	—	—	0.67
5.21 ～ 5.30	76	73 (96.0)	3(4.0)	—	—	0.27

(* + stomach less than 1/3 full)
A. Month, date, B. Number of specimen, C. Number of individual feed : a. None, b. Present, c. Mean weight

released at the same time show a growth of 28-38 mm for the body length, an average of 34.7 mm and 0.19-0.30 g for the body weight, an average of 0.26 g. Compared with naturally hatched fry, the average body length for the artificially hatched fry was somewhat smaller but the body weight was greater. This is due to the relationship between the release period for the artificially hatched fry and the degree of absorption of the umbilical sac. It is thought that there is a time difference for the relationship stated above and that of the degree of absorption of the umbilical sac and the period of seaward migration of the naturally hatched fry.

Food habit: The feeding condition of fry during the seaward migration is given in Table 3.

Different from the salmon fry, the pink salmon fry are very inactive with regard to feeding in the river. As given in the table above, the fry with empty stomachs were

86.7-96.0 % of the specimen. Even when some feed was found in the stomachs, they were not full. Most of the specimen had only a small amount of feed at the end of the stomach and the average weight was 0.27-0.99 mg. The contents of feed were mainly larvae and imagoes of midge.

VI Study

The seaward migration of pink salmon in their natural condition has not been investigated sufficiently. There is only information obtained from the investigation of the ecology of salmon fry in the Nishibetsu River (Kobayashi and Harada, 1966). According to this information, it was conjectured that pink salmon fry emerge from the natural spawning bed and commence the seaward migration from the middle of April to the middle of June, the same period as that for the seaward migration of salmon fry.

This time, when pink salmon were spawned in early October, at the height of spawning season, the fry indicated a seaward migration from early May to the end of May which concurred with that of the group naturally spawned in the Nishibetsu River.

The artificially hatched fry that were hatched and grown in the river water were also released between April and June. The group of fry from the eggs collected in early to the middle of October, at the height of spawning period, reached a growth stage suitable for the release in early to the middle of May. Therefore it was concluded readily that

the naturally spawned fry were hatched and grown under the same water temperature conditions in which the temperature goes down in winter as used for hatching (the river water) at the Iwaobetsu Project Hatchery. This substantiates the results of the investigation of the conditions of natural spawning (Kobayashi, 1967).

From the results of the growth measurement and the analysis of food habit of the fry naturally spawned, it was found that the fry commenced seaward migration immediately after they emerged from the spawning bed and that the growth and the amount of feed taken were very small. Different from the salmon fry, they did not stay and feed for a while in the river. This also agrees with the results of the investigation at the Nishibetsu River (Kobayashi and Harada, 1966). Most of the specimen had empty stomachs. Therefore it is thought that the specimen were taken immediately after their emergence from the spawning bed. This agrees with the result obtained by Mcdonald (1960).

The seaward migration, growth and food habit of p. 5
pink salmon fry naturally spawned show in part the characteristics of the species to adapt themselves to the natural environment which were obtained over a long period of time. Therefore it is necessary to treat them through understanding of their essential qualities when they are under artificial management.

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VII Summary

The seaward migration of pink salmon fry spawned naturally from the 8th to the 10th of October in 1965 occurred from early to the end of May. This agreed with the time of release of the artificially hatched fry that were hatched and grwon in the river water. This proves that the fry naturally spawned hatch and grow in the river water which goes down in temperature during winter.

The growth and feeding of the fry are very slight. It was found that the fry emerged from the spawning bed to commence their seaward migration immediately.

These facts should be taken into consideration in the promotion of artificial management as being characteristics of pink salmon obtained over a long period of time.

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The downstream migration of pink salmon fry from the natural spawning area in which the spawning occurred during the period from 8th to 10th of October in 1965 took place from the early to the late of May in 1966.

It was recognized that the eggs and embryos of pink salmon develop under the varying water temperature influenced by the air temperature in winter.

The downstream migration of pink salmon fry after the emergence from the gravel seems to be done by the direct movement of the water current.

The amount of food in the stomach of pink salmon fry revealed very small. The pink salmon fry showed almost no growth